FOREST PEST MANAGEMENT
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# BIOLOGICAL EVALUATION OF TABLE MOUNTAIN CAMPGROUND

Dave Schultz, Entomologist
James Allison, Plant Pathologist

## ABSTRACT

Table Mountain Campground on the Valyermo Ranger District, Angeles National Forest, was evaluated for pest problems. Major losses can be attributed to annosus root disease and western dwarf mistletoe in Jeffrey pine. True mistletoe in white fir and black oak, and bark beetles killing a few pines on the edge of root disease centers are currently minor problems. Regeneration is apparently being hampered by high populations of rodents. Biology of the pest organisms is discussed and seven stand management options are detailed to aid in decision making.

## INTRODUCTION

Arthur L. Smith, District Ranger of the Valyermo Ranger District, requested an evaluation of the Table Mountain campground. Dave Schultz and James Allison from the Forest Pest Management Staff examined the campground on June 3 and 4, 1981.

## OBSERVATIONS

Table Mountain Campground is located about a mile north of the Angeles Crest Highway at an elevation of 7,000 ft. There are 118 parking spurs within the campground. The topography within the campground limits is level to gently sloping. The longterm normal precipitation at nearby Big Pines Park is 25.05 inches per year, although the 1980-81 winter precipitation was about 40-50 percent of normal. The only tree species occurring within the campground limits are Jeffrey pine, white fir and California black oak.

USDA, FOREST SERVICE, PACIFIC SOUTHWEST REGION
State and Private Forestry, Forest Pest Management
630 Sansome Street, San Francisco, California 94111

The two pests having the greatest impact at the current time are annosus root disease and dwarf mistletoe in the pine. There is a limited amount of true mistletoe in the white fir and black oak. Insect activity is currently limited to bark beetles killing a few pines around the edge of some annosus root disease centers and twig beetles killing branches of moisture-stressed white firs. Some tree aggregations within the campground have basal areas in excess of 300 square feet per acre. Evidence of ground squirrels and/or gophers was widespread, which may explain the lack of tree reproduction in the campground. The attached map shows the location of the major problems in the campground.

## BIOLOGY OF PEST ORGANISMS

### ANNOSUS ROOT DISEASE

Fomes annosus is a root rotting fungus that attacks a wide range of woody plants, causing a decay of wood and death of sapwood and cambium. All conifer species in California are susceptible to the fungus. Hardwood species are rarely damaged or killed; but madrone, Arbutus menziesii, and a few brush species including manzanita, Arctostaphylos spp., and sagebrush, Artemisia tridentata, are attacked.

During favorable periods, the fungus forms fruiting bodies in decayed stumps, under the bark of dead trees, or in the duff at the root collar. The fungus becomes established in freshly cut stumps from air-borne spores produced by the conks, and then grows into the root system. The fungus subsequently spreads to healthy roots of surrounding susceptible tree species via root contacts. Local spread of the fungus outward from a stump typically results in the formation of disease centers with dead trees in the center and fading trees on the margin. These centers usually continue to enlarge until they reach barriers such as openings or groups of non-susceptible plants.

The fungus may remain alive for as long as 50 years as a saprophyte in infected roots and stumps. Young susceptible tree species often become infected and die after their roots contact old infected root systems in the soil.

### DWARF MISTLETOE

The dwarf mistletoes are parasitic seed plants that attack only conifers. Western dwarf mistletoe infects Jeffrey, ponderosa, knobcone, and Coulter pines. The dwarf mistletoes are obligate parasites which are completely dependent on their host for support, for water, and for most of their mineral and organic nutrients. They often cause the formation of "witches' brooms", or dense masses of distorted branches, on the host which divert nutrients from the rest of the tree.

Dwarf mistletoes spread between trees and within crowns of trees by means of small seeds that are forcibly ejected into the air. Spread from overstory to understory is limited to the distance traveled by the seeds,

usually 20-60 feet, but as much as 100 feet if assisted by wind. Dwarf mistletoe spreads upward in infected trees at a rate of about 4 inches/year.

TRUE MISTLETOE

True mistletoes were present in the campground on both California black oak (Phoradendron villosum ssp. villosum) and white fir (Phoradendron boleanum ssp. pauciflorum). The true mistletoes are usually considered to be curiosities, but they can be serious pests where individual trees are of high value. Species of Phoradendron are essentially "water parasites" and are less demanding of their hosts than the dwarf mistletoe.

True mistletoe infections are spread mainly by birds -- including robins, blue-birds, thrushes, and cedar waxwings — that feed on the berries. Birds digest the pulp of the berries and excrete the living seeds, often depositing them onto susceptible trees. A viscous coating and hair-like threads on the outer surface of the seeds attach them firmly to twigs and branches, where they germinate and infect the host tissues.

Young or small trees are seldom infected by leafy mistletoe. In nearly all cases, initial infection occurs on larger or older trees because birds prefer to perch in their tops. Severe buildup of mistletoe often occurs in an already-infected tree because birds are attracted to and may spend prolonged periods feeding on the mistletoe berries.

Trees heavily infected by true mistletoe are weakened, reduced in growth rate, and sometimes killed. Weakened trees are predisposed to attacks by insects and often die during drought or other periods of stress. Heavy infection of white fir can result in top kill in combination with the fir engraver beetle (Scolytus ventralis). Branches and tree tops heavily-laden with true mistletoe often break during wind storms and trunk swellings may provide an entrance point for decay fungi, increasing the hazard to people and property in campgrounds and other developed sites.

JEFFREY PINE BEETLE

The Jeffrey pine beetle, Dendroctonus jeffreyi, attacks only Jeffrey pine. There is one generation per year with adults attacking trees from late March through October. Only the bole of the tree is attacked, and the insect will not breed in the branches or slash. The Jeffrey pine beetle normally attacks scattered individual trees which are predisposed by overmaturity, lightning strike, root disease or extremely heavy infections of dwarf mistletoe or Elytroderma disease. This beetle has an aggregating pheromone which serves to attract other Jeffrey pine beetles into the area of a tree under attack. Once the beetles are near the initial tree under attack, they may be able to overcome other, healthy trees by their sheer numbers. In years of adequate precipitation, mortality due to the Jeffrey pine beetle usually occurs as single trees or several trees growing close to each other. When precipitation is below normal, the Jeffrey pine beetle can kill larger groups of trees, including some apparently healthy trees.

Jeffrey pines in the campground which are currently in, or on the edge of annosus centers will probably become infected with root disease and will be attacked by the Jeffrey pine beetle. Pine mortality outside infection centers can be kept at a low level by measures designed to maintain or increase vigor of the trees. Pruning large dwarf mistletoe brooms from overstory trees and thinning younger stands that are infected will increase tree vigor and make them more resistant to bark beetles. Reducing the total basal area to 150 sq. ft./ac., or less where grass or brush is present, will probably result in less bark beetle-caused mortality during future periods of reduced precipitation. Rapid destruction or disposal of fresh pine slash will prevent the buildup of pine engravers, Ips spp., that would otherwise cause top killing and predispose trees to the Jeffrey pine beetle. Vehicular traffic, construction and paving can be routed away from trees and their root zones to avoid wounding and root compaction that will predispose the trees to bark beetle attack.

PINE ENGRAVER BEETLE

Pine engravers, Ips spp., will breed either in the tops of live pine trees or in fresh green slash. Attacks on live trees are usually limited to trees which are suppressed, or stressed by dwarf mistletoe, root disease, drought, fire, or the attack of other insects. If fresh slash is available in the spring, the pine engravers may build up in an area and cause locally heavy top killing by mid-summer. Attacks are made with the coming of warm weather in the spring. A new generation is produced in 6-8 weeks in the spring, to 4-6 weeks in mid-summer (August). Thus, several overlapping generations per year may be produced. The winter may be passed in any of the life stages of larvae, pupae, or adults, depending upon species involved.

Outbreaks in standing, healthy trees are sporadic and of short duration, and are often associated with some temporary stress or shock afflicting the host species, such as severe competition or sudden opening of the stand. Tree killing frequently occurs where green pine slash, which serves as breeding habitat, is left untreated during spring and summer.

Fresh pine slash caused by thinning, dwarf mistletoe control work, construction or winter storm breakage can be modified in a number of ways to make it unsuitable for pine engraver breeding. One approach to minimizing damage is to schedule slash-generating activities mostly in the late summer, fall and early winter, when the beetles are not flying or the slash has a high probability of drying out before the beetles can complete their development. Green pine slash created during the spring and summer should be treated to prevent the buildup of pine engraver populations. Because the engravers can complete their development in about a month under ideal conditions, treatment should be carried out soon after cutting to be effective. Some methods of slash treatment that might be acceptable in dispersed recreation areas would include lopping and scattering slash in sunny areas to speed its drying out, crushing or mashing slash with logging equipment to make it unsuitable for pine engraver breeding, or piling and burning the slash within a month of cutting. Broadcast burning the slash might work if it could be done while the slash was green without damaging the residual stand. Another method which might work is to pile slash in a

sunny area and tightly cover the pile with clear plastic. If the temperature under the bark of slash in all parts of the pile reaches 120°F, all brood currently in the pile will be killed. Lower temperatures will not be effective and where successful, this method will not prevent reinfestation of slash piles. The most acceptable methods of slash treatment in high-use recreation areas would probably be disposal by chipping or removal from the site.

CALIFORNIA FLATHEADED BORER

The California flatheaded borer, Melanophila californica, principally attacks Jeffrey and ponderosa pines, although they may be found in other pines.

It is most severe in stands located on sites where environmental stress is common. Decadent or unhealthy trees are most frequently attacked, along with an occasional top of a thrifty, vigorous tree.

Eggs are laid in bark crevices of the host tree. Newly hatched larvae penetrate directly through the bark to the phloem. Here the larvae may feed from a few months to 4 years withhout any apparent effect on the host tree. Should host vigor and larval abundance not allow them to succeed, the larvae cut very short galleries before they are killed. These galleries do not seriously injure the tree and are overgrown by the cambium. Should conditions be, or become, favorable for the larvae and unfavorable for the tree, the larvae develop rapidly and destroy the cambium.

Although this insect can kill trees weakened by dwarf mistletoe and root disease, its primary importance is rendering trees increasingly susceptible to bark beetles.

FIR ENGRAVER

The fir engraver, Scolytus ventralis, is a major cause of loss in white fir as well as other true firs. At the Table Mountain Campground, the fir engraver should have one generation per year. The adults usually emerge and attack new trees during the hottest part of the year - late June through August. Attacks may occur as several distinct patterns. Trees may be killed outright, may be top-killed, or may survive repeated attacks for many years. Broods often develop and emerge without destroying enough of the cambium to kill the tree. The patch of dead cambium heals over and leaves a brown pitch pocket in the wood. The beetles carry a brown-staining fungus that is apparently essential for successful brood development.

Conditions which are associated with increased mortality due to the fir engraver are Fomes annosus, periods of drought and true mistletoe infections.

TWIG BEETLES

Beetles in the genus Pityophthorus and several closely related genera usually breed in twigs and small branches. As a group, they are mildly beneficial, by the process of natural pruning. Their normal hosts are

injured, dying, dead or down trees. In rare instances, they have developed in sufficiently large numbers to attack and kill small trees growing near their breeding place. A large amount of twig beetle activity in living trees usually indicates a severe moisture stress or infection by root rot or dwarf mistletoe.

## MANAGEMENT OPTIONS

1. No change in present management. Fomes annosus will persist in the infected stumps and roots until the wood has been completely rotted. Trees on the edge of active annosus centers will become infected and will probably die after being attacked by bark beetles. Conifers planted in the infection centers will become infected and die as their roots reach old infected roots and stumps and the fungus will be perpetuated in the area. Dense thickets of young pines will probably be attacked by bark beetles or engraver beetles when precipitation drops below normal. Conifers will compete with some of the existing oak trees, resulting in a reduction of oak vigor and growth. That will slow wound healing, promoting heart rot and increasing the rate of branch and tree failures: tree hazards.

2. Reduce impact of Fomes annosus. Once annosus root disease is established in a stand, no direct procedure is available for controlling it. Control, therefore, involves prevention of new centers by decreasing the risk of stump infection, and silvicultural manipulation of infected stands to minimize the effects of the disease. The following alternatives are available:

   a. Prevent stump infection. Application of granular borax to freshly cut stumps is effective in preventing most (90%) new infections. The chemical is toxic to the spores of F. annosus, but has no effect on existing infections. Borax application is required on all stumps cut in and near developed recreation sites (FSM R-5 Supp. 2305 and 2331.33). Application requires the submission of a Pesticide Use Proposal.

   b. Plant hardwoods. Revegetation of active annosus centers should be done only with resistant species. All conifers are susceptible to the fungus. Leaving the centers barren or planting them with resistant hardwoods will result in the fungus eventually dying out so that conifers can again be regenerated. Unfortunately, this will likely take 50 or more years.

      Favoring the hardwoods already present and planting other suitable hardwoods will provide shade as well as establish a barrier of non-susceptible roots which may limit the spread of the infection centers. There will probably be fewer problems in maintaining the planting if the trees or shrubs are transplanted or grown from seed collected near the campgrounds.

c. Thinning and interplanting. Thinning of dense pole-size stands of susceptible conifer species and interplanting with resistant hardwood species will minimize opportunities for root contact and subsequent spread. Sparse stands or stands of mixed susceptible and resistant trees will be less subject to damage. Thinning will also increase tree vigor and thus reduce the risk of damaging activity by bark beetles. Stumps created during thinning must be treated with borax, and slash should be treated to minimize pine engraver buildups.

3. Thin around existing oaks. Some of the oak trees in the campground are under competition from the surrounding pines. The competition and shading have resulted in some oaks having dead branches, slow growth and slow wound healing. Thinning pines around oak trees would extend the useful life span of the oaks and may reduce the likelihood of tree failure. Conifer stumps should be treated with borax and the slash should be treated to minimize pine engraver buildups.

4. Reduce impact of dwarf mistletoe. Several alternatives for reducing the impact of dwarf mistletoe in recreational sites are available. FPM funding may be available for approved dwarf mistletoe control projects. It should be kept in mind that even if efforts to control dwarf mistletoe are successful, the trees will likely die from root rot and subsequent beetle attack if they are within active annosus centers.

a. Broom pruning. The campground has trees which would benefit from broom pruning. High-value trees can be pruned of large brooms in the lower crown if, after removal of the brooms, the trees will have live crown ratios of 30% or more. Removal of brooms would increase the vigor of the trees and extend their life.

b. Thinning of even aged stands. Thinning of infected stands will maintain optimum growth of the residuals and reduce stress. Mistletoe-infected trees should be selected against. The removal of all trees with Hawksworth dwarf mistletoe ratings of 5 and 6 should be considered because these trees will likely die within the next 10-year period, most likely during the next drought. Treat all freshly cut stumps with borax to prevent invasion of *F. annosus*.

c. Remove infected overstory trees. Removal of infected overstory trees will eliminate a source of infection for surrounding understory trees. The remaining understory can then be thinned and/or pruned to eliminate dwarf mistletoe infections.

5. Control true mistletoe. At present, control of *Phoradendron* is seldom practiced or needed in forest situations, other than selection against infected trees when practical. When control is needed for ornamental trees where values of individual trees may be high, several options are available.

a. Prune. Prune infected limbs one foot or more below the point of mistletoe attachment, preferably at the bole.

b. Wrap infected branches. Cut off the shoots flush with the limb or bole. Wrap the affected area with a band of black polyethylene to exclude light and tie in place. Since the mistletoe will not survive without light, it may die within a year or two. If the area is not wrapped with plastic, new shoots will develop. Removing new shoots each year will restrict mistletoe development, but will not kill it.

6. Control squirrels and other rodents. The area around the campground seems to support large numbers of squirrels and other rodents, and there is a general lack of oak and conifer reproduction. Whether or not the seed-eating animals are partially responsible we don't know. Generally squirrels bury more acorns than they find later for food, thus aiding oak regeneration. It may be advisable to have a wildlife biologist provide site-specific advice on this question and one other: whether reduction of the rodent population ought to be encouraged in order to reduce chances of an outbreak of sylvatic plague, with its attendant risk to visitors.

7. Integrate treatments. Management alternatives 2 through 6 are not mutally exclusive. They can be used alone or in combination in various parts of the campground to produce the desired results. Consideration of the interactions among all insects and diseases problems present will result in a successful integration of pest management strategies.

For clarification or additional information, please contact the Forest Pest Management Staff.

## NOTES ON TABLE MOUNTAIN CAMPGROUND MAP

1. Hollow tree - possible hazard
2. Probably high risk tree
3. Possibly hazardous tree
4. 300 square feet basal area
5. White fir with rotten center and lean - limited targets
6. 260 square feet basal area
7. 300 square feet basal area
8. 180 square feet basal area
9. Leaning pine with hollow butt - no target?
10. 260 square feet basal area - mostly white fir
11. Pine with more than 10 feet of lean
12. Pine with 30% butt scar leaning toward spur 56
13. Two white fir next to road with roots cut off
14. 200 square feet basal area
15. 300 square feet basal area
16. Large white fir with rotten center and dead top
17. 340 square feet basal area, tree with old dead top
18. Pine with 50% butt missing and some lean between amphitheater and road
19. Old dead limbs on tree with spotlight at amphitheater
20. Pine with dead limbs
21. White fir with scars and probable rotten butt
22. 200 square feet basal area
23. White fir with true mistletoe and dead top
24. Clump of old white fir with true mistletoe - 180 square feet basal area

25. 360 square feet basal area behind spur 107

26. White fir with true mistletoe, butt scar, exposed roots and dead top

27. True mistletoe in black oaks around toilet

28. 280 square feet basal area near toilet at picnic grounds

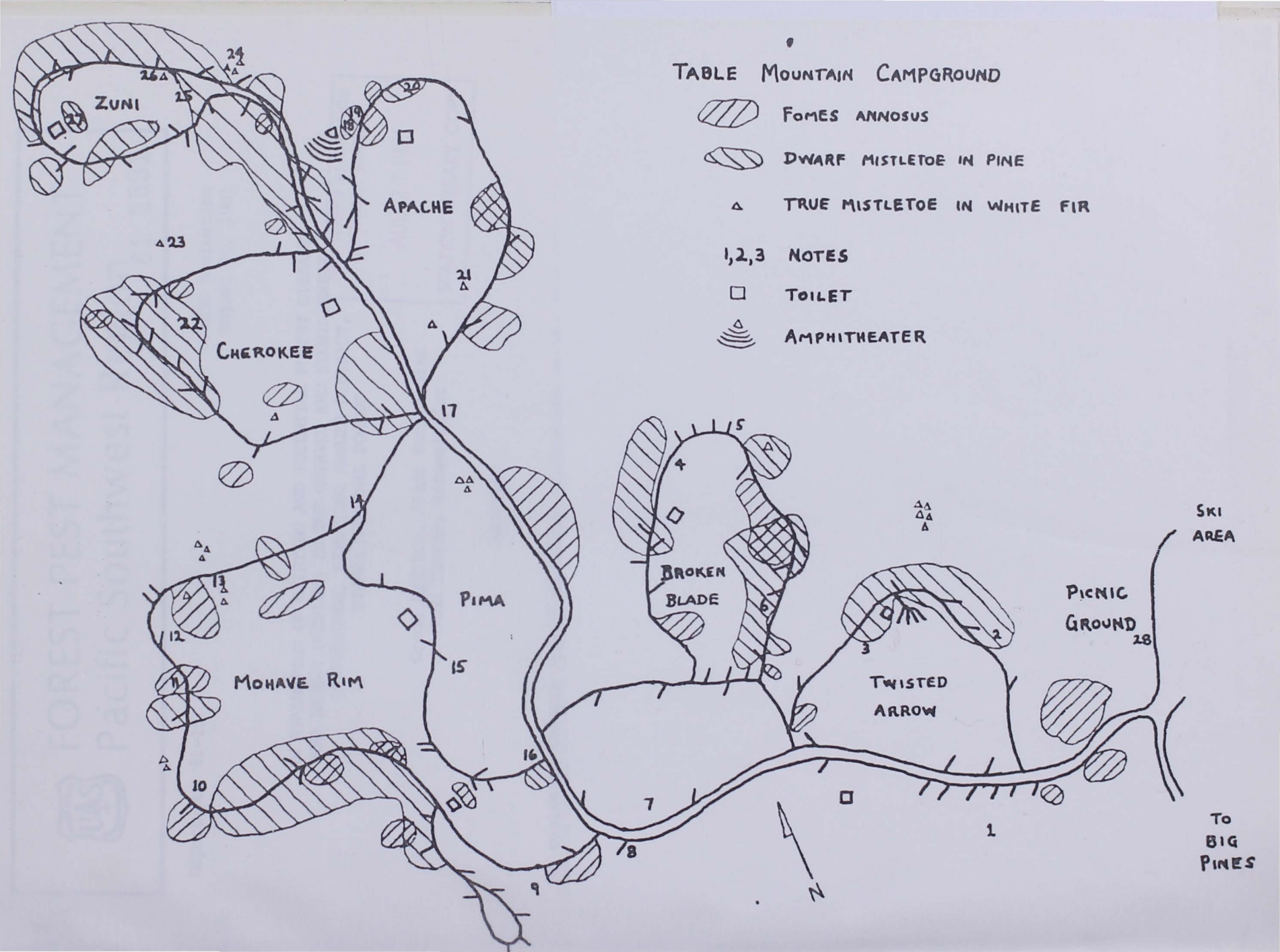
TABLE MOUNTAIN CAMPGROUND
FOMES ANNOSUS
DWARF MISTLETOE IN PINE
TRUE MISTLETOE IN WHITE FIR
1,2,3 NOTES
TOILET
AMPHITHEATER
ZUNI
APACHE
CHEROKEE
PIMA
MOHAVE RIM
BROKEN BLADE
TWISTED ARROW
PICNIC GROUND
SKI AREA
TO BIG PINES
N